Biology and host-range of *Trabala vishnu* Lefevere[1, 2]

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(*With a text-figure*)

Biology of *Trabala vishnu* Lefevere was studied in a BOD incubator at 27 ± 1°C and 60-65% relative humidity. Eggs were creamy-white and were covered with brown hairs. Incubation period was 8 to 10 days. Larvae of three different colours, namely yellow, grey and pinkish grey hatched out from the eggs of a single female. There were 5 larval instars. Total larval duration was 29 to 33 days in female and 24 to 29 days in male. Pupal period was 11 to 12 days in female and 12 to 14 days in male. Application of Dyar's law was tested to ascertain the growth and the larval instars. Out of 55 plant-species tested, 5 were accepted by the larvae. *Tecoma stans* (L.) H.B. & K. was preferred over castor, (*Ricinus communis* L.); *Syzygium cumini* (L.) Skeels was equally preferred ; *Eucalyptus botryoides* S., *Rosa* sp. and *Shorea robusta* Gaertn. f. were preferred less than castor. The host range of *Trabala vishnu* is restricted to woody plants.

The castor hairy caterpillar, *Trabala vishnu* Lefevere (Lepidoptera : Lasiocampidae), is a sporadic polyphagous pest that occurs throughout India, Burma (Fletcher 1919 and Beeson 1941), Sri Lanka (Light 1929), East Indies (Van Hall 1919) and Indo-China (Ngayen-Cong-Tien 1939). Sevastopulo (1939) and Beeson (1941) have given a general account of its biology and listed the plant species on which it feeds. Most of the hosts reported were forest trees. Since large scale deforestation has taken place in tarai region, it was thought pertinent to study the biology and host-range of this insect to explore the possibility of its being a pest of cultivated and fruit crops in the absence of wild flora on which it feeds.

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Materials and Methods

The eggs were obtained from the stock culture maintained in the laboratory on castor. The first instar larvae (0-14-hr old) were reared individually on castor leaves in plastic petri-dishes at 27 ± 1°C and 60-65% relative humidity in a BOD incubator. The observations on the biology of the insect were recorded daily and the head capsules collected at each ecdysis were stored. To determine oviposition potential, 1 male and 1 female were kept in a plastic container (12 × 10 cm). Adults were fed on 10% sucrose solution.

To test Dyar's law, head capsules of the larvae of first-second instar were measured across the greatest width of the head at the base of the mandibles with a stereomicroscope fitted with an ocular micrometer. However, in later instars the head capsule width was measured with a microscope in which scale was directly fitted. For each instar 50 head capsules were measured.

Three days after pupation, sex in pupae was determined on the basis of morphological characters in the external genitalia.

Host-range was studied in the laboratory by disc method following the procedure of Kogan & Goeden (1970). Three discs of each host measuring 1 cm^2 were cut and fixed alternately and equidistantly (i.e. standard *vs.* test plant) near the perimeter of the petri-dish with an entomological pin No. 20. Discs were held 3-4 mm above the surface. For proper fixing of pins 1 cm thick layer of plaster of paris was placed in petri-dishes whose top was lined with moist blotting paper. Tests on each plant species were replicated thrice. The fourth instar larvae, used as test insects, were isolated and starved for 24 hr. One larva in each petri-dish containing discs was allowed to feed for 90 min. The amount of feeding was measured by graph paper. The following formula of Kogan & Goeden (1970) was used to calculate the preference index :

$$C = 2A/(M + A)$$

where C = comparative analysis of plants tested (preference index), A = feeding on test plant, and M = feeding on standard plant. The index measures the relative amount of feeding on 2 species of plants present in the arena in a 0 to + 2 scale. A C-value of 1 indicates that feeding on test plant was equivalent to the feeding on the standard. A C-value > 1 indicates a preference for test plant ; and a C-value < 1 indicates a less acceptance to the test plant.

Fifty-five plant species belonging to 30 families were tested for host-range study. The arrangement of plant families is made following the system of Hutchinson (1973) who divided Dicotyledons into two main divisions, 'Lignosae' (woody plants) and 'Herbaceae' (herbaceous plants). The following plant species were tested :—

1. Pteridophyta — CYATHEACEAE — fern (*Cyathea dealbata* Swartz).
2. Spermatophyta—
   - A. Gymnospermae — PINACEAE — pine (*Pinus decidua* Wall).
   - B. Angiospermae—(Dicotyledones) Division—Lignosae.

ANACARDIACEAE—mango (*Mangifera indica* L.) ; BIGNONIACEAE—Yellow bells [*Tecoma stans* (L.) H. B. & K.] ; BRASSICACEAE—leaf mustard, rai [*Brassica juncea* (L.) Czern. & Coss. var. *cuneifolia* Roxb.], cabbage (*B. oleracea* L. var. *capitata* L.), water cress (*Nasturtium officinale* R. Br.), radish (*Raphanus sativus* L.) ; CAESALPINIACEAE—red cedar (*Acrocarpus fraxinifolius* Wight & Arn.), Kachnar (*Bauhinia variegata* L.), Amaltas (*Cassia fistula* L.), Gulmohur [*Delonix regia* (Boj.) Raf.], Ashoka tree (*Saraca indica* L.), tamarind (*Tamarindus indica* L.) ; CARICACEAE—papaya (*Carica papaya* L.) ; CHENOPODIACEAE—sugarbeet (*Beta vulgaris* L.) ; COMPOSITAE—corn flower (*Centaurea cyanus* L.), sunflower (*Helianthus annuus* L.), cone flower (*Rudbeckia bicolor* Nutt.); CUCURBITACEAE—Parwal (*Trichosanthes dioica* Roxb.) ; DIPTEROCARPACEAE—sal (*Shorea robusta* Gaertn. f.) ; EUPHORBIACEAE—chenille plant (*Acalypha hispida* Burm.), safed arond (*Jatropha curcas* L.) ; FABACEAE—bean (*Dolichos lablab* L.), soybean [*Glycine max* (L.) Merr.], Locust tree (*Robinia pseud-acacia* L.) ; LYTHRACEAE—Crapemyrtle (*Lagerstroemia indica* L.) ; MAGNOLIACEAE—Champa (*Magnolia globosa* Hk.) ; MALVACEAE—hollyhock [*Althaea rosea* (L.) Cav.], tree cotton (*Gossypium arboreum* L.), okra [*Abelmoschus esculentus* (L.) Moench] ; MELIACEAE—Mahogani tree [*Swietenia mahagoni* (L.) Jacq.] ; MORACEAE—banyan (*Ficus benghalensis* L.), peepul (*F. religiosa* L.) ; MYRTACEAE—gum tree (*Eucalyptus botryoides* S.), guava (*Psidium guajava* L.), jamun [*Syzygium cumini* (L.) Skeels], turpentine tree (*Tristania conferta* R. Br.) ; NYCTAGINACEAE—bougainvillea (*Bougainvillea glabra* Chois.) ; PUNICACEAE—pomegranate (*Punica granatum*

L.) ; ROSACEAE—Rose (*Rosa* sp.) ; RUBIACEAE—Kadam (*Anthocephalus indicus* A. Rich.), cape—jasmine (*Gardenia jasminoides* Ellis); RUTACEAE—lemon [*Citrus limon* (L.) Burm. f.], Kamini [*Murraya paniculata* (L.) Jack]; SALICACEAE—white poplar (*Populus alba* L.) ; SOLANACEAE—night jessamine (*Cestrum nocturnum* L.), tomato (*Lycopersicon esculentum* Mill.), petunia (*Petunia hybrida* Vilm.), brinjal (*Solanum melongena* L.) ; VERBENACEAE—teak (*Tectona grandis* L.).

Angiosperme—(Monocotyledones).

ARACEAE—Arum [*Colocasia esculenta* (L.) Schott] ; LILIACEAE—lily (*Lilium* sp.); POACEAE—sugarcane (*Saccharum officinarum* L.), maize (*Zea mays* L.).

RESULTS AND DISCUSSION

LIFE-HISTORY

Egg : Laid in straight double rows, occasionally also in 3 or 4 small rows. Oval, creamy white and covered with brown hairs. Measure 1.53 mm × 1.34 mm after the removal of hairs. Incubation period ranged from 8 to 10 days.

Larva : Freshly hatched larvae feed from the margin of the leaves gregariously. This habit persists up to second instar or early third instar. First instar 3.75 mm long. Body yellow with blue-black crossbands. Hairs grow prominently with the growth of larvae, giving them the characteristic appearance of hairy caterpillars. Grown up larvae are defoliators. Tender plants are attacked seriously while bigger plants may withstand their attack. There are 5 instars, except in 1 case where they were 6. Three different colours namely yellow, grey and pinkish-grey were observed in full grown larvae reared from eggs of a single female. From field collected eggs sometime grey larvae were obtained but larvae of all the three colours were found frequently. Sevastopulo (1939) has reported yellow, brownish grey, olive brown or pinkish brown and blackish forms of larvae but not from the eggs of the same female. We did not observe black larvae but we consider that grey and yellow forms might exist in nature. Pinkish-grey larvae could be from the cross of yellow and grey. All the three types of colour in larvae from single female suggests the existence of heterozygous condition of the population in nature. Sevastopulo (1939) and Beeson (1941) reported 6 larval instars, which are not in accordance with the present investigation. The full grown larva measures on an average 5.06 cm in length. They have fine network of vertical and horizontal lines. Pencil-like dark brown hairs arise from the first somite in all instars. Average larval period for both the sexes was 28.3 days (Table 1).

Pupa : Pupae were reddish-brown. Pupation took place inside the cocoon on the surface of the glass-jar and on the paper. In nature cocoons were found on leaves or on the stem of leaves. The colour of cocoon was same as that of the larvae. Each cocoon has 2 humps on dorsal side and 2 openings, one on each end. From the one opening final moult occurs and from the other the adult emerges. Male cocoons were smaller in size than female cocoons ; male pupae were also smaller in size than female pupae, their size varied from 1.76 to 2.26 cm and from 2.26 to 3.02 cm respectively.

An attempt was also made to sex pupae on the basis of morphological characters in the external genitalia. In the female pupae bursa copulatrix (BC) is present on the eighth sternite, whereas the oviporus (O) on the ninth sternite (Fig. 1). The eighth and ninth segments on ventral side are divided completely. In male pupae the ninth sternite has 2 small, oblong pads on each side of the mid-ventral line. The prepupal and pupal periods were longer in males than in females (Table 1).

TABLE 1

DURATION (DAYS) OF VARIOUS STAGES OF *Trabala vishnu*

Stage	Female		Male	
	Range	Mean	Range	Mean
Larval period	29-33	31.4	24-29	26.1
First instar	5-6	5.7	5-6	5.2
Second instar	4-5	4.2	4-5	4.4
Third instar	4-5	4.8	3-5	4.1
Fourth instar	5-8	6.9	4-7	5.5
Fifth instar	7-10	9.3	6-8	6.8
Prepupal period	1-2	1.6	2	2.0
Pupal period	11-12	11.5	12-14	13.0
Adult longevity	3-8	4.4	4-10	6.6
Preoviposition period	1-2	1.0		
Oviposition period	1-5	3.2		
Postoviposition period	0-1	0.3		
Fecundity	22-297	187.5		

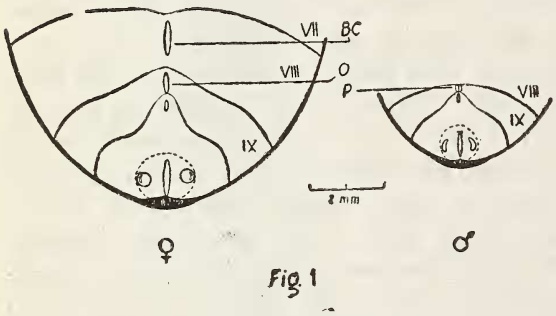

Fig. 1. Ventral side of the female and male pupae of *Trabala vishnu*.
(BC = bursa copulatrix, O = oviporus, P = pad)

Adult : The male moths are green, with an average wing expanse of 4.79 cm, whereas, females are thick, sluggish and greenish yellow or yellow, with big anal tufts. They measure 6.20 cm across the wings. Bipectinate antennae were present in both sexes but bristles were quite large in males. Female lived shorter than males. A peculiar habit of the adults was that costal edge of the hind wings was projected in front of the forewing while at rest.

Oviposition : A female after a successful copulation laid on an average 187 eggs (with a range of 22 to 297 eggs) within five days. Females also lay eggs parthenogenetically ; the number in such cases varied from 40 to 289 eggs/female. Parthenogenetically laid eggs did not hatch even up to 2 months. Preoviposition and oviposition periods were 1-2 days and 0-1 day respectively.

Dyar's law

Application of Dyar's law (Dyar 1890) was tested in the present investigation. It was found that there was no overlapping between the head-capsule widths in all the instars (Table 2). Growth ratios calculated for different instars did not show much variation except for the second and third instars where a little deviation was observed. When log values of average head-capsule width were plotted

TABLE 2

RELATION OF HEAD-CAPSULE WIDTH AND DIFFERENT INSTARS OF *Trabala vishnu*

Instar	Observed head-capsule width (mm)		Growth ratio
	Range	Average *	
I	0.863-0.984	0.917 (-0.038)	
II	1.292-1.468	1.374 (0.138)	1.503
III	2.038-2.480	2.244 (0.351)	1.633
IV	3.000-3.800	3.376 (0.528)	1.504
V	4.200-7.300	5.208 (0.717)	1.542

* Data mentioned in the parentheses indicate log values.

against the instars a clear straight line relationship was observed, indicating that growth in successive instars was in regular geometrical progression and follows Dyar's law. This also indicates that no instar was omitted during the investigation.

Host-range

Out of the 55 plant species tested, 5 were acceptable to the larvae of *T. vishnu* when castor (*Ricinus communis* L.) was used as a standard host. Their relative preference is given below:—

Type of preference	Test plant	Preference index
More preferred	*Tecoma stans*	1.55
Equally preferred	*Syzygium cumini*	1.03
Less preferred	*Rosa* sp.	0.50
	Eucalyptus botryoides	0.17
	Shorea robusta	0.17

Larvae did not feed on Pteridophytes and on Gymnosperms in Spermatophytes. Among Angiosperms only Dicotyledonous plants were selected as its food and among Dicotyledons only those belonging to Lignosae. *Tecoma stans* was preferred to castor and is being recorded as its new host. Beeson (1941) reported that its larvae feed on guava but our studies did not support it, perhaps because of varietal difference. Jamun was equally preferred to the standard host ; sal and gum tree were acceptable to larvae but were much less preferred to castor. Rose was better preferred than sal and gum tree. No field, fruit or vegetable crops were accepted by the larvae in our investigation.

To confirm whether the host-plant range of *T. vishnu* is restricted only to Dicotyledons, the plant species reported in literature (Lefroy 1909, 1971 ; Fletcher 1917, 1919 ; Anstead 1918 ; Beeson 1919, 1941 ; Van Hall 1919 ; Light 1929 ; Pruthi 1936 ; Ngayen-Cong-Tien 1939 and Sevastopulo 1939) were also taken into consideration. From the combined information it was observed that the preference of this insect was restricted only to Dicotyledons. However, 3 plant species, namely *Berberis asiatica* DC., *Pelargonium* sp. and *Verbascum thapsus* L. were found as its host in Herbaceae group of Dicotyledons. In Myrtales (Myrtaceae, Lythraceae, Combertaceae) there were 13 host species belonging to 8 genera. From Euphorbiaceae family 3 plant species, including castor, were reported as its hosts. Thus it was concluded that the preference of *T. vishnu* is restricted to woody plants.

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